**Malachi Eberly**

# Project 2 GANs Report

## Model Architecture

I decided to use simple feed-forward neural networks for both the Generator and the Discriminator. Determining an effective structure for each network took some research, but what I landed on turned out to produce decent results. For the Generator, I used a five-layer architecture where the size of each layer increased from a 100-dimensional noise input layer to a layer of 1024 neurons, then back down to match the size of the 28x28 image for the output layer. I used Leaky ReLU for the activation functions besides the output layer because it allows for negative values. For the Discriminator, I matched the linear structure and the number of neurons because it should work in an opposite manner to the Generator. However, I also added a layer to go from 128 neurons to the one output layer so that the network could classify the input as real or fake. I also made sure to incorporate dropout to prevent co-adaptation of neurons and overfitting. I used a learning rate of 1e-4 and a batch size of 64 because they seemed to provide the best results.

## Training Process

I trained over 50 epochs of the Fashion MNIST data set. The results are available on the associated Jupyter notebook. At first, the Generator only provides gray noise. However, the results quickly improve, and by epoch 16, the outline of the images is mostly clear. Each epoch took 938 steps, and because I used a batch size of 64, it left a batch of 42 at the end of each epoch, so I had to implement a dynamic batch size in training so that it didn't crash. At epoch 41, the Discriminator began to have more loss than the Generator, and at this point, the Generator's results were fairly impressive. A plot of the losses is also available on the Jupyter notebook.

## Encountered Challenges and Solutions

The data preparation and model creation were straightforward, but I encountered challenges with setting up the training loop. It was difficult to make sure tensor sizes matched, it took some time finding the pattern of alternating between the Generator and Discriminator, and examining performance was also challenging because of the training time. To solve these issues, I did some more research on training GANs, went through my tensors step by step, and used fewer epochs when still editing the training loop.

## Potential Applications and Ethical Considerations

GANs have a lot of potential in generating realistic pictures. They seem to be trained for a specific type of picture because of the nature of their datasets and how the Discriminator works. This raises some ethical considerations, such as ensuring that they aren't used maliciously with deep fakes.